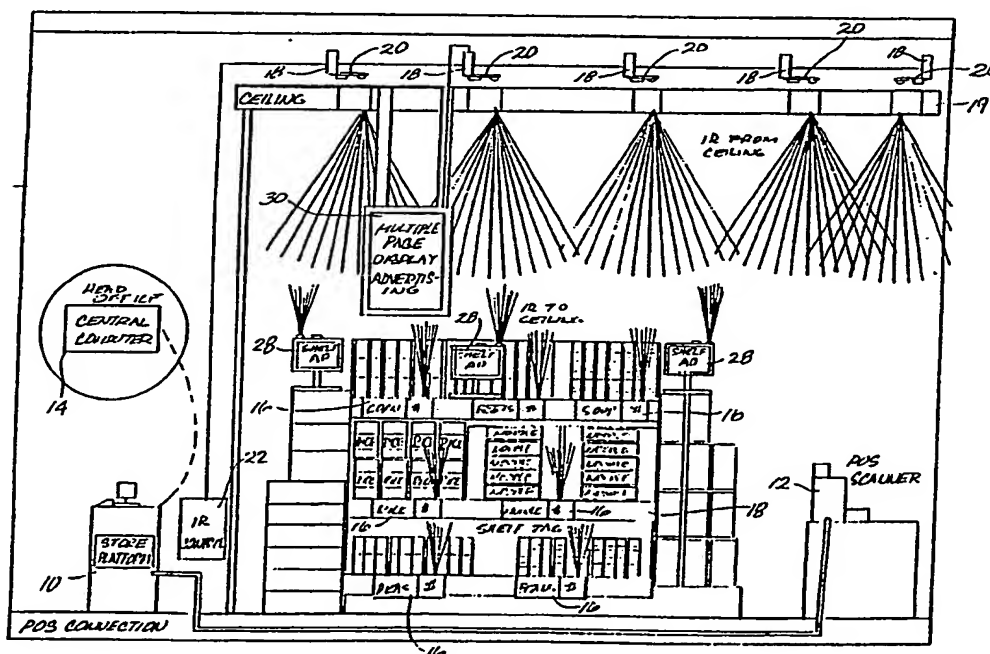




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## (54) Title: REMOTE ELECTRONIC INFORMATION DISPLAY SYSTEM



## (57) Abstract

An electronic information display system uses a digital computer (14) to control the transmission and reception of pricing and advertising information from a central grid (18-20) of IR transceivers to and from remote locations where the transmitted information is visually displayed (16, 18, 28, 30).

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**REMOTE ELECTRONIC INFORMATION DISPLAY SYSTEM****Field of the Invention**

This invention relates generally to an electronic information display system, and, more particularly, to a computer based system for displaying pricing, advertising, and other specialized information at remote display modules which are either optically or electronically connected to a central computer.

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**Background of the Invention**

Most modern retail stores implement some form of computer technology in their operations. This typically consists of using point of sale (POS) systems for automating the checkout procedures. A POS system generally has one or more automated check-out terminals which is capable of sensing and interpreting the Universal Product Code (UPC) printed on each item of merchandise to be checked out. Each of these terminals is connected to a computer which processes the UPC information. The computer's data base includes a list of items of merchandise on sale, a UPC for each of these items, and various types of information, including pricing and inventory information, associated with each UPC. When a customer is ready to make a purchase, the store clerk simply uses an automated terminal to sense the UPC markings on each of the customer's selections. The computer interprets the

35

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1       UPC, looks up the price for each item, and keeps a  
running total of the purchase. For a chain of retail  
stores, each of the store platform computers are often  
linked to a central computer. This allows the data  
5       base of each store to be modified by changing only the  
date base of the central computer.

          In a store, merchandise offered for sale is  
typically displayed in some way, usually by placing the  
merchandise on a shelf. Plastic or paper pricing  
10       indicators are commonly mounted in proximity to the  
merchandise to notify customers of its price. Pricing  
indicators often include information such as size,  
weight, unit price and other identifying information.

          When a change in price is made to one or more of  
15       the merchandise items, two things must occur. First,  
the computer's data base must be modified to reflect  
the price change. As soon as this change occurs, the  
new price will automatically be charged to customers at  
the check-out terminal. Second, the price indicator  
20       for each of the affected items must be changed. It is  
desirable to change the data base and the indicated  
price at the same time so that there are no  
discrepancies.

          There are many disadvantages with this type of  
25       set-up, the main one being that whenever any of the  
indicator information has to be changed, it must be  
done so manually. This requires that new pricing tags  
must be ordered, printed and delivered to the store and  
then manually placed on the store shelves. Associated  
30       with this procedure is the cost of printing and  
delivering indicators and the labor cost to replace out  
of date pricing indicators. This is especially  
disadvantageous where price changes occur often.

          Many stores also use alternative means to convey  
35       pricing and other information about merchandise to its  
customers. Some stores use handwritten or pre-printed  
displays that are somewhat larger than the tags that

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1 are used on the shelves. These displays may be self-  
standing and portable or may be fixed to a shelf or a  
ceiling. With each of these methods, however, the  
store is faced with the cost of printing and installing  
5 the displays each time they are changed.

U.S. Pat. No. 4,002,886 to Ronald M. Sundelin  
dated Jan. 11, 1977 discloses an electronic price read  
out system in which preprinted price indicators are  
replaced by electronic price indicator units. The  
10 information displayed by these units can be changed at  
will by changing the electrical stimulus at the input  
of each unit. Each of the electronic price indicator  
units is connected to the same computer that supplies  
prices to the POS terminals. This way the system  
15 assures that whenever the price of an item is changed  
in the computer's data base, both the price displayed  
and the price charged at the check-out terminal are  
automatically changed to the new price. The Sundelin  
patent discloses that the computer is connected to the  
20 price indicator units using four conductors or wires.  
This feature makes the system difficult to implement as  
it requires wires to be routed throughout the store.  
In order for the computer to differentiate between the  
many price indicator units, each unit is assigned a  
25 unique address. Correlation in the computer database  
between the price indicator unit address and the price  
to be displayed is achieved either by manually entering  
the information into the computer via its keyboard or  
by using a remote unit connected to the store computer,  
30 the keyboard of the computer that is capable of reading  
the address of the price indicator unit, and the UPC on  
the merchandise.

U.S. Pat. No. 4,766,295 to Malcolm H. Davis  
discloses a similar system; however, the store computer  
35 is connected to the price indicator units via an infra  
red communications link. One disadvantage to the  
system disclosed in the Davis patent is that there is

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1       only a one way communication between the computer and  
the price indicator unit. That is, the system only  
allows for information to be transmitted from the  
computer to the price indicator unit.

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#### Summary of the Invention

      The present invention provides an integrated  
pricing and advertising system for displaying current  
pricing information as well as advertising information  
10       on remote display terminals throughout a store. The  
system has a store platform computer which provides a  
data base for pricing and advertising information  
within each store. The store platform computer is  
connectable to a central computer which may be located  
15       off-site. A plurality of point of sale (POS) terminals  
are linked to the store platform computer. A plurality  
of electronic price information display tags are  
mounted throughout the store at various merchandise  
locations. Each display tag is battery powered and  
20       contains a transceiver for communication with the store  
platform computer. Communication between the store  
platform computer and the display tags is facilitated  
with an IR controller and an IR transceiver grid. The  
IR transceiver grid is comprised of a plurality of  
25       individual transceivers placed throughout the store and  
it is optically linked to the transceivers resident in  
each of the electronic display tags. The IR controller  
is a microcomputer-based terminal which is hardwired to  
both the store platform computer and the IR  
30       transceiver. The IR controller regulates the  
transmission and reception of data to and from the IR  
transceiver. A portable terminal which is coupled to  
and can communicate with both the store platform  
computer and the electronic display tags is used to  
35       initialize display tag addresses. Included in the  
system are portable electronic display terminals with  
transceivers for communication with the store platform

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1 computer as well as display terminals that are hard  
wired to the IR transceiver.

According to a feature of the invention, the IR  
transceivers and the display tags are both individually  
5 addressable. As a result of this double level of  
addressability, only the IR transceiver or transceivers  
actually communicating with the display tags are  
addressed and transmit IR signals. Thus, when the  
display tags are configured to have a low gain standby  
10 mode and to switch to a high gain mode only when  
receiving IR signals, battery power for the display  
tags is conserved because only those display tags in  
the vicinity of the display tag to be addressed are  
switched to the power consuming, high gain mode.

15 According to another feature of the invention,  
two-way communication is established between the IR  
transceiver and the display tags so that the price data  
to be displayed by the display tags or an error check  
signal can be transmitted back to the IR controller to  
20 verify that the correct price data has been received by  
the display tag.

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1     Brief Description of the Drawings

          These and other features and advantages of the present invention will be better understood by reference to the following detailed description when  
5     considered in conjunction with the accompanying drawings, wherein:

          FIG. 1 is a block diagram of the information display system;

          FIG. 2 is a block diagram of the specific elements  
10    of the electronic information display system shown in their operative relationship with each other;

          FIG. 3 is a schematic diagram of the IR controller, the IR transceiver grid, and the display tags; and

15    FIG. 4 is a diagram of the message words transmitted between the IR controller and the display tags via the IR transceiver grid and the timing of such message words.

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1     Detailed Description of the Invention

Referring to FIG. 1, a block diagram of the information display system is shown. The store platform computer 10 provides a data base for all of the merchandise in the store. The data base associates each item of merchandise with, among other things, the price of the item, and its (UPC). The store platform computer 10 is electrically connected to a plurality of point of sale (POS) terminals 12. The POS terminals are used to sense the UPC code on the items of merchandise, the UPC is interpreted by the POS terminal, and the UPC is sent to the store platform computer. The data base in the store platform computer is referenced and the price associated with that particular UPC code is found and added to the running total of the purchase.

Price changes may be made in the data base at the store platform level; however, if the store platform computer is linked to another computer 14, one that serves as a central computer to a plurality of store platform computers, then price changes can be made at the central computer 14 and downloaded to each of the store platform computers 10.

The store platform computer also supplies data, in addition to providing data to the POS terminals, to a plurality of electronic display tags 16. Display tags are used to convey pricing and other information about the particular item of merchandise the tag is associated with.

The display tags have the ability to store and then display information as a function of time. This ability allows price changes and other information to be displayed at a specific time and day without the need of communication with the tag at that specific time and day. This feature makes it possible for relatively instantaneous changes to all tags even though the system may have slow data communication

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1 rates. In addition, power consumption of the tag is  
reduced since the largest power consumption exists when  
communication is taking place. One communication can  
program many changes in displayed information.

5 The information display system is integrated into  
the POS system by adding to the described POS system an  
IR controller as well as communications software both  
within the IR controller and the Store Platform  
10 computer. The assembly language listing of the  
application code for the IR controller is attached  
under Appendix A and is hereby incorporated by  
reference. The application program listing for the  
store platform computer is attached in Appendix B and  
is hereby incorporated by reference.

15 In an exemplary embodiment, merchandise is placed  
on shelving 18 within the store and an electronic  
display tag is mounted on the shelf adjacent to each  
item of merchandise. Each of the display tags may  
indicate various information relating to that  
20 particular item, such as the total cost, the cost per  
unit, the size or weight, etc.

Each of the electronic display tags contain an  
infra-red (IR) emitter for transmitting data and an IR  
sensor for receiving data. Each tag is uniquely  
25 identified by a binary address which is stored in  
random access memory RAM within the tag. This allows  
the address of the tag to be changed from time to time.  
The electronic display tags are powered by a battery  
which operates the IR sensor in two modes. To reduce  
30 battery power consumption, the IR sensor amplifier is  
normally maintained in a low gain mode. When an IR  
signal is radiated toward the display tag, the IR  
sensor amplifier is switched to a high gain mode. By  
way of example, a high gain mode could be enabled or  
35 energized periodically to detect when an IR signal is  
present. If during an enabled period an IR signal is  
received, the IR sensor receiver is maintained in the

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1 high gain mode for a predetermined time period after  
the IR signal ceases.

5 The electronic display tags communicate with a  
grid of IR transceivers 18 which, in an exemplary  
embodiment, are housed in the ceiling of the store.  
Only one of the IR transceivers is illustrated in FIG.  
1. The IR transceiver grid is made of an array of IR  
emitters and IR sensors 20 which are positioned at  
selected positions in the ceiling 19. It is not  
10 necessary to have a direct line of sight between the  
transceivers in the display tags and the transceivers  
in the ceiling since infrared signals may be reflected.  
The number and location of the IR emitters and IR  
sensors in the IR transceiver grid depends on the  
15 number and location of the electronic display tags. In  
any case, each IR transceiver 18 communicates with only  
a relatively small number of the total number of  
display tags 16 in the store. For example, if the  
store has 20,000 display tags, there could be 300 IR  
20 transceivers each communicating with about 50 to 75  
display tags in its vicinity, the grid of IR  
transceivers being spaced apart two to four feet and  
overlapping somewhat the display tags with which they  
communicate.

25 The IR transceiver grid 18 is connected to the IR  
controller 22 which is in turn connected to the store  
platform computer 10. The IR controller is a  
microcomputer-cased terminal that controls transmission  
from and reception of the IR transceiver grid. The IR  
30 controller provides two basic functions. It converts  
parallel binary data into a serial stream of coded data  
for transmission from the IR transceivers. The IR  
controller also converts coded serial data from the IR  
transceivers to parallel binary data.

35 The IR transceiver grid and electronic display  
tags are also capable of communicating with the hand  
held unit 24. The hand held unit has an IR emitter and

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1 an IR sensor for communicating with other transceivers,  
a keypad for entering information, and scanning means  
for sensing and interpreting UPC markings on items of  
merchandise.

5 When a new item is added to the store's inventory,  
the hand held tag is used by an operator to initialize  
the electronic display tag so that the tag will display  
information pertaining to only that item of  
merchandise. First, the clerk uses the hand held unit  
10 to scan the UPC marking on the new item. The UPC is  
then transmitted from the hand held unit to the store  
platform computer via the IR link between the hand held  
unit and the applicable IR transceiver. The computer  
processes the UPC and assigns a product identification  
15 code to that item and the product identification code  
is transmitted back to the hand held unit via the IR  
link. The operator then uses the hand held unit to  
inject the code into the electronic display tag. This  
is done optically via the wireless link between the IR  
20 emitter in the hand held unit and the IR sensor in the  
electronic display tag. In order to avoid  
miscommunication with a nearby display tag, the hand  
held unit must be held in close proximity to the  
display tag. The hand held unit then advises the store  
25 platform computer that the download is complete. Once  
complete, the tag is able to communicate to the store  
platform computer via its own transceiver.

During this initialization process, additional  
information may be supplied to the data base. For  
30 example, the operator may use the hand held unit to  
tell the store platform computer where the item is  
located in the store.

The information supplied to the electronic display  
tag remains intact until it is changed on command by  
35 the store platform computer. For example, when the  
price of an item changes, the price change is entered  
into the store platform computer by an operator. Once

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1 the data base changes, the new price is available for  
the POS terminals. The operator will also instruct the  
store platform computer to update the price on the  
electronic display tag which is associated with that  
5 item. The store platform computer will send a message  
containing the price change over the IR transceiver  
addressed to the appropriate electronic display tags.

In the preferred embodiment, there are two levels  
of addressability. IR transceivers 18 are each  
10 assigned unique addresses and display tags 16 are each  
assigned unique addresses. A particular IR transceiver  
will only transmit an IR signal to the display tags in  
its vicinity if it first receives a message word having  
an address that matches the address assigned to the IR  
15 transceiver. Thus, fewer than all the IR transceivers  
usually transmit IR signals and only those display tags  
in the vicinity of such IR transceivers are switched to  
the high gain mode. As a result, battery power is  
conserved. As described above, only the display tag  
20 assigned the address that matches the address of the IR  
signal responds to the display tag data carrier by such  
IR signal.

As illustrated in FIG. 3, display tags 16 transmit  
to and receive IR signals from IR transceivers 18 in  
25 their vicinity. Some price tags may receive IR signals  
from more than one transceiver, but, nevertheless, in  
the preferred embodiment, fewer than all of them to  
conserve battery power. An instruction field  
determines what such display tag does with the display  
30 tag data field, e.g. changes the displayed price.  
Two-way IR transmission takes place between the IR  
transceivers and the display tags. Message words  
having the display tag address and the display tag data  
are transmitted from the IR transceivers to the display  
35 tags, and signals to verify receipt of correct display  
tag data are transmitted from the display tags to the  
IR transceivers. Preferably, the verifying signal is

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1 a simple data-valid signal comprising a unique code  
word of several binary bits, which is sent by a display  
tag when the display tag data it receives satisfies a  
parity check. Alternatively, although it would consume  
5 more battery power, the verifying signal could comprise  
a retransmission of the display tag data to the IR  
transceiver for comparison with the data it had sent.  
In either case, the display tag data is retransmitted  
by the controller if the verifying signal is not  
10 received by the IR transceiver.

As shown in FIG. 4, when new display tag data is  
to be sent to a display tag, the controller transmits  
an acquisition signal to all the IR transceivers at a  
time T1. The acquisition signal has an IR transceiver  
15 address field and a check sum field that carries parity  
bits to verify that the correct acquisition signal has  
been received by the IR transceivers. At a time T2,  
the addressed IR transceiver transmits a send data  
signal to the controller if parity checks. Then, at a  
20 time T3, a display tag signal is transmitted by the  
controller. Only the addressed IR transceiver, i.e.  
the transceiver that transmitted the send data signal,  
responds to the display tag signal. The display tag  
signal has a display tag address field, a check sum  
25 field that carries parity bits to verify that the  
correct display tag address has been received, a  
display tag instruction field that defines the function  
to be performed, a display tag data field that defines  
the price or other data to be displayed by the tag, and  
30 a check sum field that carries parity bits to verify  
that the correct display tag data has been received.  
The instruction field could identify the type of data  
in the display tag data field and how it is to be used  
by the display tag. At a time T4, the addressed IR  
35 transceiver transmits a data valid signal to the  
controller if parity checks. At a time T5, the  
addressed transceiver transmits to the display tags in

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1        its vicinity an IR signal modulated with the display  
tag signal. At a time T6, the addressed display tag  
transmits a data valid signal to the IR transceiver.  
The data valid signal is one binary value if parity  
5        checks and another binary value if parity does not  
check. At a time T7, the addressed transceiver  
transmits a message completed signal to the controller.  
The message completed signal has a data valid field  
that carries the binary value transmitted at time T6,  
10        a display tag address field, and a check sum field that  
carries parity bits to verify that the correct message  
completed signal is transmitted to the controller. If  
the data valid field of the message completed signal  
received by the controller indicates that parity does  
15        not check, i.e. that the display tag data received by  
the display tag is incorrect, the controller repeats  
the described sequence until the data valid field does  
indicate a parity check. If the send data signal at T2  
or the data valid signal at T4 is not received by the  
20        controller or the message completed signal at T7  
received by the controller does not satisfy the parity  
check, the controller also repeats the described  
sequence. If desired, an alarm could be actuated after  
the sequence is repeated unsuccessfully a given number  
25        of times, e.g. ten times.

      In an exemplary embodiment, all of the IR emitters  
in the IR transceiver concurrently transmit the same  
information. Accordingly, each of the electronic  
display tags receive the same information; however, the  
30        only tag that responds to the information by changing  
its display is the tag that has an address which  
matches the transmitted address.

      In the described embodiment, each of the  
electronic display tags have a separate transceiver.  
35        In an alternate embodiment of the present invention, a  
group of electronic display tags, each having their own  
unique address, are connected to one regional

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1 transceiver. Each of these regional transceivers has  
associated with it, control circuitry to de-multiplex  
the incoming information to the appropriate electronic  
display tag. For example, a regional transceiver is  
5 located at each isle of shelving. That transceiver  
receives and transmits all of the information related  
to the display tags mounted on that particular isle.

In an exemplary embodiment of the present  
invention, the system also includes display and  
10 advertising mechanisms in addition to the display tags.  
For example, information is displayed on movable  
display screens 28 which are substantially larger than  
the display tags. These screens operate in  
substantially the same way as the display tags, being  
15 programmable and having a self contained transceiver  
for communication with the hand held unit and the store  
platform computer. Additional screens 30 may be  
hardwired to the IR transceiver for direct  
communication with the store platform computer.  
20 Further, the display screens may either be battery  
powered or connected to a facility power source.

The preceding description has been presented with  
reference to the presently preferred embodiment to the  
invention shown in the drawings. Workers skilled in  
25 the art and technology to which this invention pertains  
will appreciate that alterations and changes in the  
described structures can be practiced without departing  
from the spirit, principles, and scope of this  
invention.

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## 1       WHAT IS CLAIMED IS:

5       1.    An    electronic    merchandise    advertising,  
management and display system for a retail store having  
rows of merchandise display (POP) locations, the system  
comprising:

          an electronic price information display tag  
mounted at each location;

10       a central computer for coordinating price,  
product, and location data at the store;

          a plurality of POS terminals linked to the  
computer;

          wireless communication links between the tags  
and the computer;

15       an electronic display terminal in proximity  
to each row of locations; and

          means for linking the display terminals to  
the computer to display information about the  
merchandise at a plurality of locations in such row.

20

          2.    The system of claim 1, in which the linking  
means is wireless.

25       3.    The system of claim 1, in which the linking  
means is hard wired.

          4.    The system of claim 1, in which the display  
terminals are self-powered.

30       5.    The system of claim 1, in which the display  
terminals are connected to a facility power source.

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1           6.    The system of claim 2, in which the wireless  
links comprise transceivers at each display tag, a grid  
of conductors connecting the computer to a plurality of  
points each uniformly spaced from a group of the  
5   display tags, and a transceiver at each point connected  
to the grid.

          7.    An electronic merchandise advertising,  
management and display system for a retail store having  
10   rows of merchandise display (POP) locations, the system  
comprising:

          an electronic price information display tag  
mounted at each location;

          a central computer for coordinating price,  
15   product, and location data at the store;

          a plurality of POS terminals linked to the  
computer;

          wireless communication links between the tags  
and the computer;

20           a first group of electronic display terminals  
fewer in number than the tags in proximity to the  
respective rows of locations;

          a second group of electronic display  
terminals fewer in number than the first group in  
25   proximity to the respective rows of locations;

          wireless communication links between the  
computer and the respective display terminals of the  
first group; and

30           hard wire communication links between the  
computer and the respective display terminals of the  
second group.

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1           8.    The system of claim 7, in which the wireless  
links comprise transceivers at each display tag, a grid  
of conductors connecting the computer to a plurality of  
points each uniformly spaced from a group of the  
5   display tags, and a transceiver at each point connected  
to the grid, the wireless communication links between  
the computer and the respective display terminals of  
the first group comprise transceivers at each of the  
display terminals of the first group adapted to  
10   communicate with the transceivers at points connected  
to the grid and the hard wire communication links  
comprise hard wire connections from the display  
terminals of the second group to the central computer  
directly or indirectly.

15

9.   An electronic merchandise advertising,  
management and display system for a retail store having  
rows of merchandise display (POP) locations, the system  
comprising:

20           an electronic price information display tag  
mounted at each location;

          a central computer for coordinating price,  
produce, and location data at the store;

25           a plurality of POS terminals linked to the  
computer;

          wireless communication links between the tags  
and the computer;

30           a first group of electronic display terminals  
fewer in number than the tags in proximity to the  
respective rows of locations;

          a second group of electronic display  
terminals fewer in number than the first group in  
proximity to the respective rows of locations;

35           the communication links between the computer  
and the first and second groups of display terminals;  
and

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1           the first group of terminals being self-powered and the second group being connected to a facility power source.

5           10. An electronic merchandise display system for a retail store having rows of merchandise display (POP) locations, the system comprising:

          an electronic price information display tag mounted at each location;

10           a central computer for coordinating price, product, and location data at the store;

          a plurality of POS terminals linked to the computer;

          transceivers at each display tag;

15           a grid of conductors connecting the computer to a plurality of points each uniformly spaced from a group of the display tags;

          a transceiver at each point connected to the grid to establish wireless communication links with the transceivers at the display tags;

20           wireless communication links between the tags and the computer;

          an electronic display terminal in proximity to each row of locations; and

25           means for linking the display terminals to the computer to display information about the merchandise at a plurality of locations in such row.

30           11. The system of claim 1 in which the wireless communication links comprise a plurality of transmitters hard wired to the central computer, each transmitter being responsive to a unique transmitter address and a plurality of receivers at the respective display tags responding to unique tag addresses, the central computer transmitting a transmitter address and a tag address when it transmits the data to a display tag.

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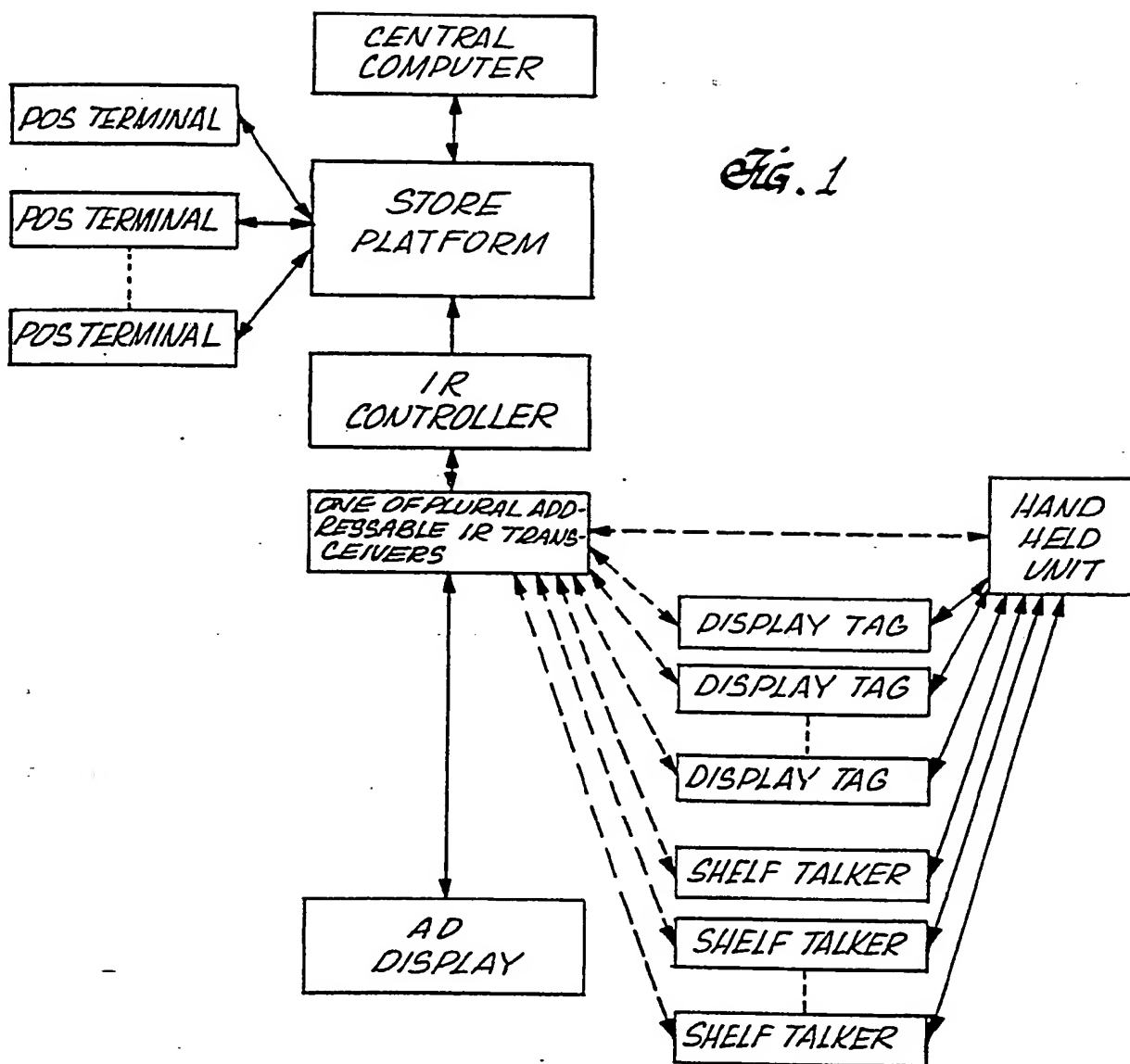
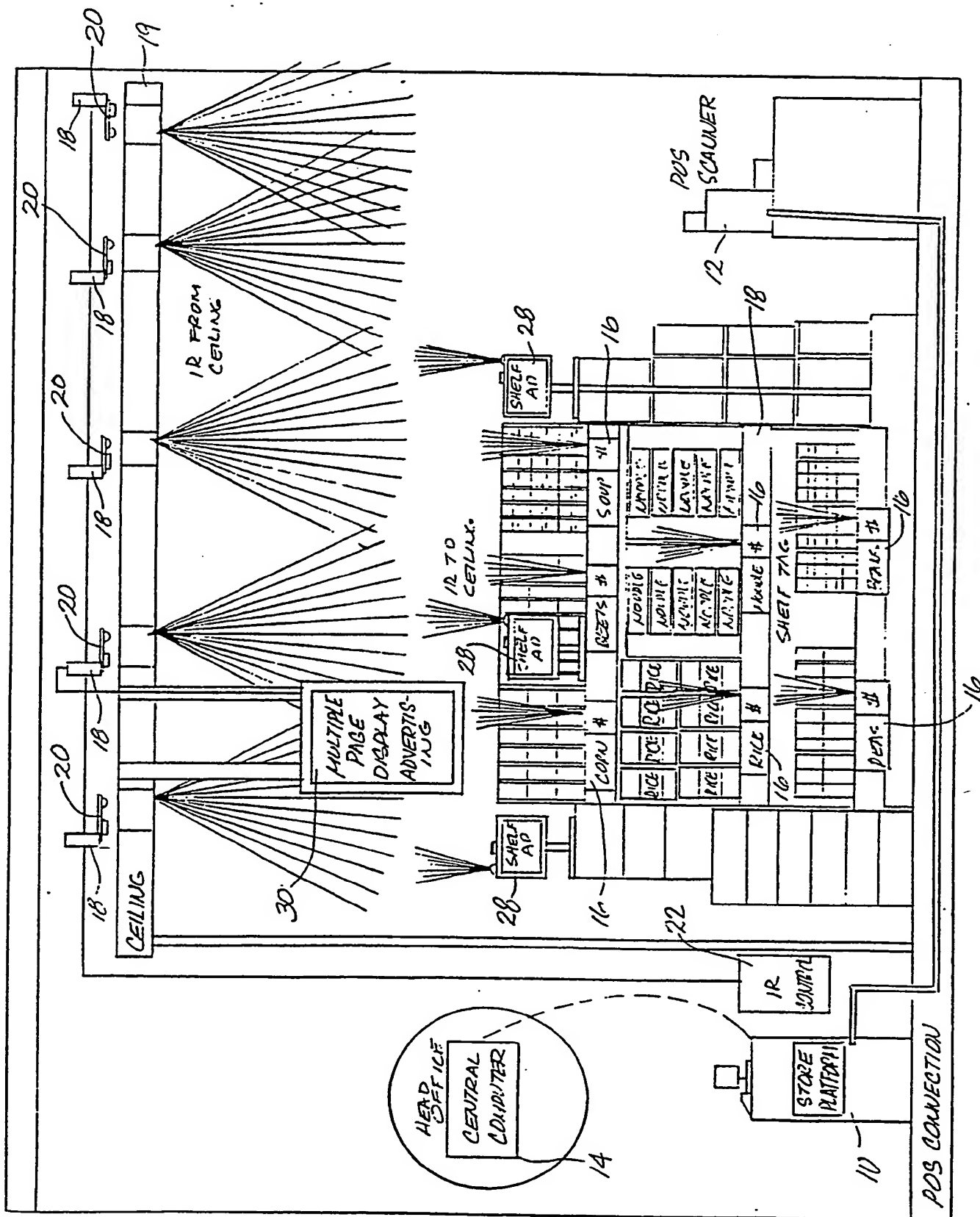
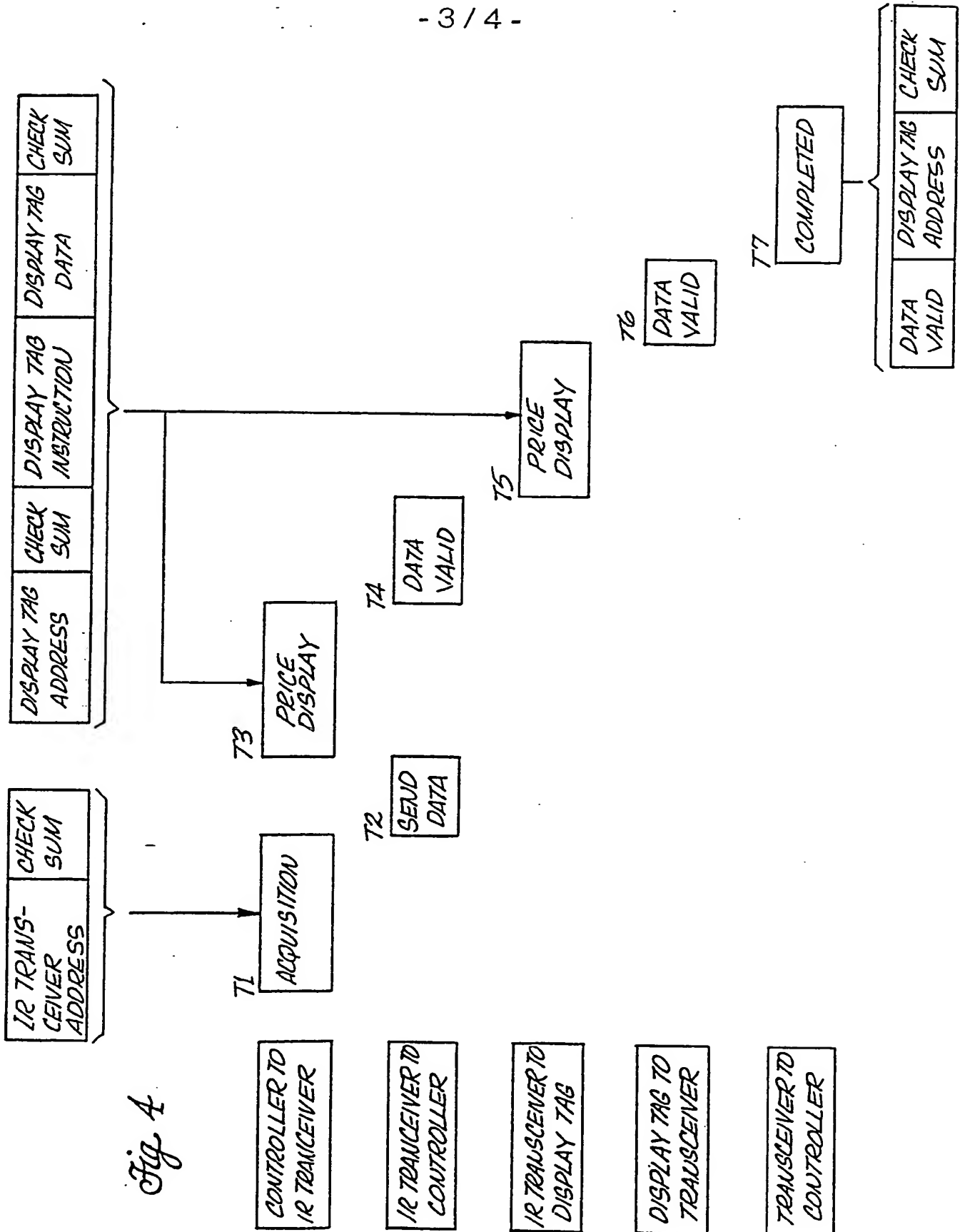
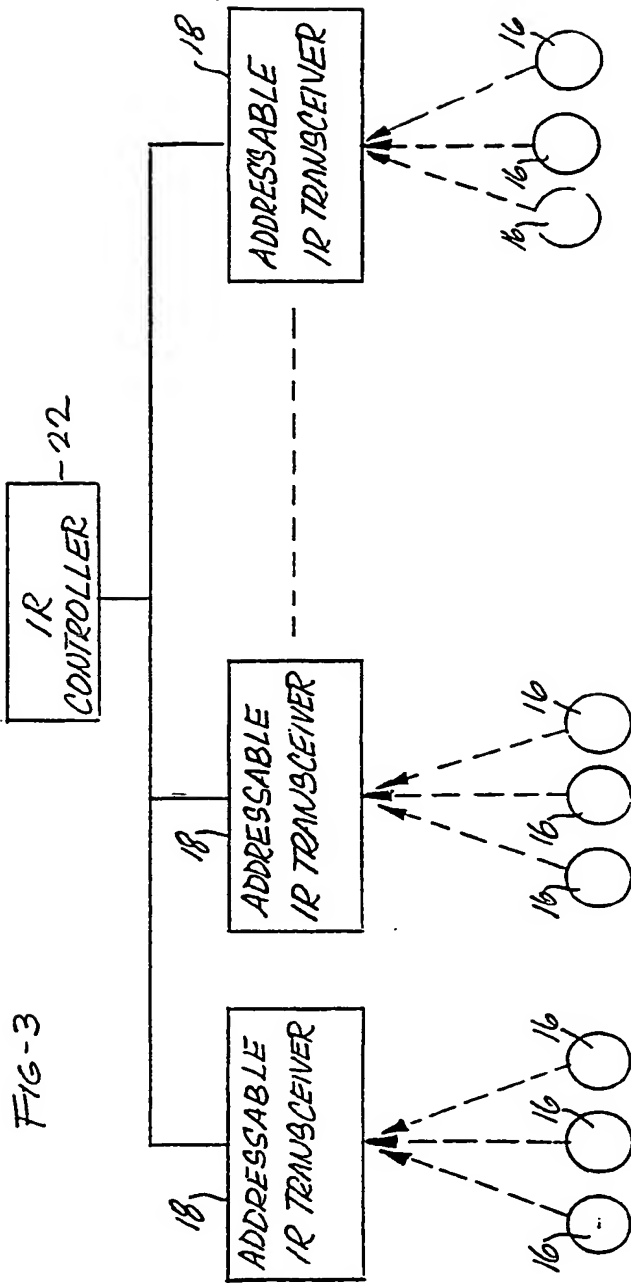


Fig. 2







# INTERNATIONAL SEARCH REPORT

International Application No. PCT/US90/02708

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) <sup>3</sup>

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC (5) : G06F 15/16  
U.S. Cl : 364/518

## II. FIELDS SEARCHED

Minimum Documentation Searched <sup>4</sup>

Classification System	Classification Symbols
U.S.	364/518; 340/825.07, 825.15; 455/604

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched <sup>5</sup>

## III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>14</sup>

Category <sup>6</sup>	Citation of Document, <sup>15</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No. <sup>18</sup>
Y	US,A 4,002,886 (SUNDELIN) 11 January 1977 See the entire document.	1-11
Y	US,A 4,139,149 (CREPEAN ET AL) 13 February 1979 See the entire document.	1-11
Y	US,A 4,237,537 (PITCHES ET AL) 02 December 1980 See the entire document.	1-11
Y	US,A 4,500,880 (GOMERSALL ET AL) 19 December 1985 See the entire document.	1-11
Y	US,A 4,421,677 (SARWIN) 04 June 1985 See the entire document.	1-11

(CON'T)

<sup>6</sup> Special categories of cited documents: <sup>15</sup>

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

## IV. CERTIFICATION

Date of the Actual Completion of the International Search <sup>3</sup>

10 AUGUST 1990

Date of Mailing of this International Search Report <sup>3</sup>

4 OCT 1990

International Searching Authority <sup>1</sup>

ISA/US

Signature of Authorized Officer <sup>20</sup>

DAVID L. CLARK

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, <sup>16</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No <sup>18</sup>
Y	US,A 4,766,295 (DAVIS ET AL) 23 August 1988 See the entire document.	1-11
A,P	US,A 4,882,724 (VELA ET AL) 21 November 1989 See the entire document.	1-11
A,P	US,A 4,888,709 (REVESZ ET AL) 19 December 1989 See the entire document.	1-11